

HIV Antibody Seroprevalence Among Prisoners Entering the California Correctional System

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A cross-sectional blind study was conducted in the spring of 1988 to estimate the extent of human immunodeficiency virus (HIV) infection among inmates entering the California correctional system. Of the 6,834 inmates receiving entrance physical examinations during the study period, 6,179 (90.4%) had serum tested for the presence of HIV antibodies after routine blood work was completed and personal identifiers were removed. Seroprevalence was 2.5% (95% confidence interval, 2.1% to 3.0%) among the 5,372 men tested and 3.1% (95% confidence interval, 2.1% to 4.5%) among the 807 women tested. Seroprevalence was more than twice as high among men arrested in the San Francisco Bay Area as in those arrested elsewhere in the state. The regional differences in HIV seroprevalence observed among entering inmates mirror infection rates reported among intravenous drug users from the same regions.

(Singleton JA, Perkins CI, Trachtenberg AI, et al: HIV antibody seroprevalence among prisoners entering the California correctional system. *West J Med* 1990 Oct; 153:394-399)

The management of human immunodeficiency virus (HIV) infection and the prevention of HIV transmission in correctional facilities are among the most challenging problems now confronting prison officials. Many inmates have a preincarceration history of intravenous drug use, and both intravenous drug use and homosexual activity are known to occur in prisons.¹⁻⁴ Persons infected with HIV may therefore enter the prison system and transmit the virus within prison if there is no intervention.

Most states have initiated some form of HIV antibody testing among prisoners, with results to date indicating a wide range of HIV seroprevalence rates. Unlinked epidemiologic studies of HIV seroprevalence have been conducted in ten state correctional systems since 1985 (Table 1).⁵⁻¹¹ In these studies, HIV testing was done after all personal identifiers were removed from blood specimens drawn for other purposes. The seroprevalence of HIV was highest among inmates in New York (17% among men, 19% among women) and Maryland (7% among men, 15% among women). Other states reported HIV seroprevalence rates of 1.4% or less.

Unbiased estimates of HIV seroprevalence among inmates are also available from 13 states that have adopted a policy of mandatory HIV testing of incoming prisoners.⁷ In the federal system, which tests 10% of new inmates and all inmates on release, seroprevalence was 2.0% among the 37,694 new and released prisoners tested from June 1987 through October 1988.¹² In Nevada the rate was 2.5% among 3,820 inmates tested in 1985.⁵ Other jurisdictions with mass screening policies have reported seroprevalence rates of 1.5% or less and were typically states with a relatively low cumulative incidence of the acquired immunodeficiency syndrome (AIDS).⁵ None of the five states with the highest cumulative AIDS incidence—New York, New Jersey, Florida, California, and Texas—currently screen all entering prison inmates for HIV infection on a mandatory basis.

The majority of state and federal correctional jurisdictions separately house inmates with confirmed diagnoses of AIDS. As of April 1988, at least ten states maintained separate housing for all inmates with known HIV infection, including those with asymptomatic infections.⁷ California has followed this policy since 1985. As of July 1, 1988, the California Department of Corrections housed 176 inmates with known HIV infections (9 women and 167 men) at three facilities.*

To date, HIV testing in the California correctional system has been done only on consenting inmates when clinically indicated or upon inmate request. Because there currently are disincentives for prisoners to be voluntarily tested—that is, HIV seropositivity leads to segregated housing with AIDS patients and the loss of access to work programs—it is likely that the actual number of inmates with HIV infection is higher than the number presently identified by voluntary testing. State legislation mandating HIV antibody testing of all incoming prisoners in California has been proposed several times in recent years.

The California Department of Health Services, at the request of and in collaboration with the California Department of Corrections,[†] conducted a cross-sectional blind study during the late spring of 1988 to estimate HIV seroprevalence among incoming prisoners. Only existing demographic data and blood specimens drawn at routine medical examination on entrance to prison were used. The purpose of this study was to estimate the extent of HIV infection among entering inmates to assess future needs for housing and medical services and to provide data to assist in targeting AIDS prevention and risk-reduction activities.

*As of June 30, 1990, of the 525 inmates with known HIV infection, 95 were participating in three pilot projects to determine the feasibility of integrating inmates with HIV infection into the general prison population (Chris Cummings, California Department of Corrections, oral communication, August 13, 1990).

†Charles C. Jew, MA, Amnon Igra, PhD, Chris Cummings, and Nadim Khoury, MD, of the California Department of Corrections assisted in the planning and conduct of this study.

ABBREVIATIONS USED IN TEXT

AIDS = acquired immunodeficiency syndrome
 ELISA = enzyme-linked immunosorbent assay
 HIV = human immunodeficiency virus
 HIV-Ab = HIV antibody

Subjects and Methods

Population Studied

All incoming prisoners in California receive a routine physical examination shortly after arrival at the reception center, during which a blood specimen is obtained and tested for communicable diseases. The study population consisted of all prisoners scheduled to have venipuncture in association with physical examinations on entrance to the California correctional system from April 18, 1988, through May 13, 1988. Data collection from incoming women prisoners included an additional four-week period of May 23, 1988, through June 17, 1988.

Adult male prisoners are processed for entrance into the California correctional system at seven reception centers. Two reception centers receive prisoners arrested in the San Francisco Bay Area (San Francisco, Alameda, Contra Costa, Marin, San Mateo, Santa Clara, and Solano counties). Three reception centers receive prisoners arrested in southern California (Imperial, Inyo, Kern, Los Angeles, Orange, Riverside, San Bernardino, San Diego, San Luis Obispo, Santa Barbara, and Ventura counties). One reception center receives prisoners arrested in the remaining 40 counties located in central and northern California. The final reception center receives civil narcotics offenders from throughout the state, who receive drug treatment while incarcerated.

Within a region, the particular reception center to which a person is sent also depends on his or her commitment status. For this study, incoming male prisoners were classified either as parole violators returned to custody without a new term or as "new commitments." Approximately 80% of new commitments were not on parole when arrested for their admitting sentence, and 20% were parole violators with new terms.

Adult female prisoners enter the correctional system through three reception centers. One reception center receives all civil narcotics commitments, another receives parole violators from southern California and all new commit-

ments, and the third receives parole violators arrested elsewhere in the state.

Data Collection

Data were collected using protocols approved by the California State Health and Welfare Agency Committee for the Protection of Human Subjects. Procedures were in accordance with California statutes that allow blind HIV antibody testing of serum collected for other purposes.¹³ Consent is not required under these conditions if test results cannot be linked to a specific person. Following guidelines for blind HIV antibody testing developed by the Centers for Disease Control, new information cannot be collected from subjects solely for the purposes of the study. Information on risk behavior was therefore unavailable because it is not routinely obtained as part of the entrance examination.

Serum remaining after routine tests were done was placed in a separate vial, refrigerated, and sent to the HIV testing laboratory on a daily or weekly basis. Because of logistic and confidentiality concerns, vials were labeled only with the facility code and, for men, commitment status—parole violator or new commitment. Sex and geographic area where the crime was committed (San Francisco Bay Area, southern California, or north-central California) were facility-specific. Each reception center maintained a log of the number of physical examinations performed during the study period, which was compared with the number of specimens tested for the presence of HIV.

Laboratory Methods

All serum specimens were tested for the presence of human immunodeficiency virus antibodies (HIV-Ab) by the enzyme-linked immunosorbent assay (ELISA). Serum that was repeatedly reactive on ELISA was confirmed by Western blot. Western blots were interpreted according to criteria of the Association of State and Territorial Public Health Laboratory Directors and Centers for Disease Control.¹⁴ Specimens that were indeterminate on Western blot were tested by immunofluorescence.¹⁵

Statistical Methods

Confidence intervals of 95% for HIV-Ab seroprevalence rates were calculated assuming binomial distributions for the number testing positive.¹⁶ Seroprevalence rates in subgroups were compared using ratios of rates as estimates of

TABLE 1.—Human Immunodeficiency Virus (HIV) Seroprevalence From Unlinked Epidemiologic Studies in State Correctional Systems

State	Year	Type of Prisoner	Number Tested	HIV Seropositive, %	Source
Indiana	1987	New inmates	602	0.2	Hammett, 1988 ⁵
Iowa	1986	New inmates	859	0.0	Glass et al, 1988 ⁶
Maryland	1985	New male inmates	748	7.0	Hammett, 1988 ⁵
Maryland	1985	All new female inmates	39	15.4	Hammett, 1988 ⁵
Michigan	1986	New inmates	571	0.9	Hammett, 1988 ⁵
Mississippi	1987	New and current	1,000	1.4	*
New Mexico	1987	All new	501	0.8	Greenspan, 1988 ^{7*}
New York	1988	New female inmates	450	18.9	Smith et al, 1989 ⁸
New York	1988	New male inmates	494	17.4	NY State Dept of Health, 1988 ⁹
Oregon	1987	All new inmates	977	1.2	Andrus, 1989 ¹⁰
Tennessee	1988-1989	All new inmates	1,490	0.9	†
Wisconsin	1986	New male inmates	997	0.3	Wisc Div of Health, 1988 ¹¹

*From a survey of the 50 states and the Federal Bureau of Prisons conducted by the California Department of Corrections in July 1988 (Charles C. Jew, MA, written communication, August 2, 1988).

†Bernard H. Ellis, MA, MPH, AIDS Program, Bureau of Health Services, Tennessee Department of Health and Environment, written communication, May 20, 1989.

relative risk. Approximate 95% confidence limits were calculated for relative risks using the test-based method of Miettinen; for stratified comparisons relative risks were estimated by the method of maximum likelihood.¹⁶

Results

Sample Tested

During the study period, 6,834 inmates received intake physical examinations (Figure 1). Of these, 90.4% had serum tested for the presence of HIV-Ab. Of the 652 inmates whose serum was not tested, 425 were lost to testing because serum specimens were not saved or were lost or damaged. For the remaining 227 inmates, a blood specimen could not be drawn or an insufficient quantity was left for HIV-Ab testing after routine blood work. Western blots were not done on three specimens owing to laboratory error, and these are excluded from the study. Of the 6,179 serum specimens tested for HIV-Ab, 160 were positive (135 men and 25 women). The 14 specimens that were indeterminate on Western blot were negative on immunofluorescence and are considered negative for the purpose of analysis—included in the denominator.

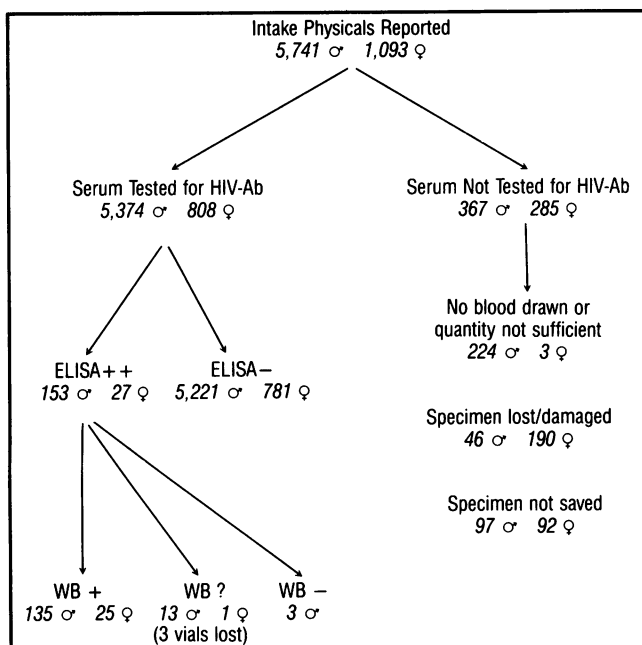


Figure 1.—During a 4-week period, human immunodeficiency virus seropositivity (HIV-Ab) of 6,834 prisoners entering the California correctional system was tested. Serum repeatedly positive on two enzyme-linked immunosorbent assays (ELISA) were confirmed by Western blot (WB). + = positive, ? = indeterminate, - = negative

Table 2 shows the demographic distribution of inmates entering the California correctional system during the study period. This distribution was not significantly different from that of inmates entering during the previous 12 months.

Seroprevalence

Table 3 presents HIV-Ab seroprevalence among the 6,179 inmates tested, by commitment status and sex. The overall seroprevalence among men was 2.5% (95% confidence limits, 2.1% to 3.0%); the rate among women was 3.1% (95% confidence limits, 2.1% to 4.5%). The overall rates for women and men were not significantly different (relative risk, 1.2; 95% confidence limits, 0.8 to 1.9).

Overall, 5.3% of men arrested in the San Francisco Bay Area were found to be HIV-Ab-positive (Table 4). Men arrested in this region were significantly more likely to be HIV seropositive than those from southern California (relative risk, 2.7; 95% confidence limits, 2.0 to 3.9) and elsewhere in north-central California (relative risk, 4.4; 95% confidence limits, 2.4 to 8.1). The difference in seroprevalence rates between those arrested in southern California (1.9%) and those arrested in northern or central California (1.2%) was not statistically significant.

Among men, parole violators had a somewhat higher seroprevalence rate than other groups tested (Table 3). This increase was not statistically significant, however, and comparison within geographic areas showed no consistent direction to the difference (Table 4).

Comment

This study is the largest blind seroepidemiologic survey so far reported of HIV prevalence among prisoners (Table 1). Several states with mandatory HIV screening have tested more prisoners but, with the exception of Nevada, reported low HIV seroprevalence and have a low incidence of AIDS.⁵

Although the inability to collect information on risk behavior in this blind study limits the interpretation of these data, they provide important information on the current scope of HIV infection in persons entering the California correctional system. This study indicates that the overall HIV-Ab seroprevalence among persons entering the California correctional system in the late spring of 1988 was approximately 2.6%. Specifically, male and female inmates appear to be equally likely to be infected on entrance to the correctional system, new civil narcotics offenders are no more likely to be infected than other new inmates, and the geographic area of arrest strongly affects the likelihood of being infected.

TABLE 2.—Demographic Distribution of Inmates Entering the California Correctional System in April-May 1988*

Age, yr	Men, % (n = 5,880)†				Women, % (n = 1,123)			
	White	Black	Hispanic	Other	White	Black	Hispanic	Other
<25.	5.9	10.3	8.2	1.0	4.8	5.9	5.8	1.1
25-29. . . .	8.2	12.1	8.4	1.1	9.6	9.7	8.8	1.1
30-34. . . .	6.2	9.0	5.4	0.6	9.3	9.8	6.3	2.1
35-39. . . .	3.9	5.3	2.8	0.5	6.9	4.5	3.4	1.7
>39.	3.9	3.5	3.1	0.4	3.9	2.8	1.7	0.8
All.	28.1	40.3	27.9	3.6	34.5	32.7	26.0	6.8

*Data were obtained from the California Offender Based Information system. This sample is representative of but does not exactly correspond to the sample of inmates tested for the human immunodeficiency virus (HIV) because there is a lag between the date of entry into the prison system and the date of the intake physical examination and because not all inmates scheduled for examinations during the study period were tested for HIV (see text).

†Totals do not add up to 100% due to rounding.

TABLE 3.—*Human Immunodeficiency Virus Antibody (HIV-Ab) Seroprevalence Among Prisoners Entering the California Correctional System**

Sex	Commitment Status	Persons Tested, No.	HIV-Ab Positive, No.	Prevalence, %	95% Confidence Interval, %
♂	Parole violator (PV)	2,336	67	2.9	2.3-3.6
	New commitment (NC)	2,846	64	2.2	1.7-2.9
	Civil narcotics PV	83	1	1.2	0.0-6.5
	Civil narcotics NC	107	3	2.8	0.6-8.0
	All men	5,372	135	2.5	2.1-3.0
♀	PV and NC	679	23	3.4	2.3-5.0
	Civil narcotics PV and NC	128	2	1.6	0.4-5.5
	All women	807	25	3.1	2.1-4.5

*Study period was 4/18/88 to 5/13/88 for men and 4/18/88 to 5/13/88 and 5/23/88 to 6/17/88 for women. The dates of entry refer to dates of the receiving medical examination, which may be several days after official entry into the prison system.

This study provides no data on the seroprevalence of inmates already in the correctional system when the study began or on the transmission of HIV within the system. The application of these estimated rates to future entering inmates will depend on the course of HIV infection in the communities from which they come.

Selection Bias

Because an attempt was made to draw blood specimens from all incoming inmates, this study is not inherently limited by selection bias, as are studies that rely on volunteers or that target high-risk groups. Because not all of the incoming prisoners having physical examinations during the study period were actually tested, however, there is some potential for selection bias if the HIV-Ab seroprevalence rate among those tested substantially differed from the rate among those not tested. Of particular concern are those prisoners (224 men, 3 women) from whom no blood could be drawn or from whom so little blood could be drawn that an insufficient quantity of serum remained for HIV-Ab testing after routine blood work. Clinical experience indicates that such persons are more likely to be habitual intravenous drug users who have scarred or collapsed veins.

In the unlikely event that all of these 224 men would have tested positive, the overall prevalence for male prisoners would be 6.4% compared with the 2.5% among those actually tested. If none would have tested positive, the prevalence would be reduced only to 2.4%. For women, the corresponding maximum and minimum values were 3.4% and 3.1%, respectively, compared with the 3.1% among those actually tested. The actual seroprevalence of entrants is likely to be somewhat higher than the seroprevalence of those tested but lower than the maximums calculated here. For example, assuming a 20% HIV seroprevalence in the untested high-risk group, the actual seroprevalence would be 3.2% for both men and women. Other HIV seroprevalence studies of prisoners have not addressed possible selection biases; whether these studies actually had problems in drawing sufficient serum from all entering inmates is unknown.

Intravenous Drug Use and Prisoners

There is a strong correlation between the HIV seroprevalence among prison populations and the seroprevalence among intravenous drug users entering treatment from the same areas. The HIV seroprevalence from unlinked and mandatory testing of prisoners in correctional systems^{5,7,9,11} was plotted as a function of the average HIV seroprevalence among intravenous drug users from studies conducted in the corresponding states between 1984 and 1987 (Figure 2).¹⁷ The high ecologic correlation observed is supported by results from the New York correctional system where the HIV seroprevalence among entering inmates with a known history of intravenous drug use was 44% compared with 7% among inmates who said they did not use drugs intravenously.⁹ Some of the studies referenced above were conducted in prison populations; others were done in drug treatment centers, sexually transmitted disease clinics, and similar settings where self-selection may have upwardly biased the seroprevalence. The higher seroprevalence found in California, compared with the states mandatorily testing all incoming prisoners, is consistent with the higher cumulative incidence of AIDS in California.

The HIV seroprevalence among prisoners entering from the San Francisco Bay Area was found to be significantly higher than among those entering from the rest of the state. This may reflect that, as noted in Figure 2, intravenous drug users in the San Francisco Bay Area have a much higher HIV-Ab seroprevalence than those from Los Angeles and elsewhere in the state. The ecologic correlation between seroprevalence in intravenous drug users and inmates entering a correctional setting illustrates the important role

TABLE 4.—*Human Immunodeficiency Virus Antibody (HIV-Ab) Seroprevalence Among Male Prisoners Entering the California Correctional System by Region of Arrest**

Region	Commitment Status†		
	Parole Violator	New Commitment	Total
San Francisco Bay Area			
% HIV-Ab-positive ...	6.5	4.1	5.3
(95% CI)	(4.7-9.0)	(2.8-6.2)	(4.1-6.9)
No. tested	536	530	1,066
Southern			
% HIV-Ab-positive ...	2.1	1.9	1.9
(95% CI)	(1.4-2.9)	(1.3-2.6)	(1.5-2.5)
No. tested	1,410	1,882	3,292
North-Central			
% HIV-Ab-positive ...	0.8	1.6	1.2
(95% CI)	(0.2-2.2)	(0.8-3.3)	(0.7-2.2)
No. tested	390	434	824

CI = confidence interval

*San Francisco Bay Area includes the counties of San Francisco, Alameda, Contra Costa, Marin, San Mateo, Santa Clara, and Solano; the southern region includes the counties of Imperial, Inyo, Kern, Los Angeles, Orange, Riverside, San Bernardino, San Diego, San Luis Obispo, Santa Barbara, and Ventura. The remaining counties of California form the north-central region.

†Civil narcotics commitments are excluded from this table; 8 were from the San Francisco Bay Area and 18 from north-central California.

that prisons and jails could play in accessing these high-risk populations. Many such persons might not otherwise be reached by infection surveillance or control efforts.

Projections

Assuming the persons tested in this study represent a random sample of all entrants into the California correctional system over a longer period, the expected number of HIV-Ab-seropositive persons to be found if testing of all prisoners were required in the future can be estimated. Assuming a stable rate of infection in the population and based on a seroprevalence of 2.5% among men, an estimated 1,365 to 1,950 HIV-seropositive men may be identified among the 65,000 men who enter the system each year. If a 3.1% seroprevalence among women is assumed, there would be 105 to 225 seropositive women among the 5,000 women who enter California prisons each year. Because there is a lag between the time of infection and when HIV antibody levels are detectable, the total number of entering inmates with HIV infection is likely to be higher than these estimates. The total number of HIV-seropositive persons housed in the prison system at any given time would also depend on how long each HIV-seropositive inmate is incarcerated and on future increases in the number of entering inmates.

Policy Implications

These data point to both the opportunity and pressing need for reaching out-of-treatment drug users and others at risk in prisons with AIDS prevention and risk reduction messages, regardless of the testing or housing policies in the facility. Educational efforts should be tailored to the inmate population in consultation with medical and health education experts. This should be done on entry into the prison system, at frequent intervals while incarcerated, and also on release when the ability to engage in high-risk behaviors is increased. Effective educational efforts should help reduce HIV transmission within facilities, as well as in the communities in which the prisoners will live on release from the correctional system.

While most state and federal correctional systems segregate inmates diagnosed with AIDS, at least 10 of the 51 systems (including California) also segregate HIV-Ab-sero-

positive inmates.⁷ Reasons given for segregating asymptomatic seropositive inmates include to protect seropositive inmates from hostile acts by other inmates, to minimize the transmission of HIV and the potential liability that may result if transmission did occur, and to facilitate delivery of the same programs other inmates receive while also attending to their special medical and psychosocial needs. California correctional officials plan to house asymptomatic HIV-infected inmates separately from those with clinical symptoms if funds become available to implement a modular housing concept that provides equivalent facilities for subgroups of inmates.

While there may be merit in the idea of separate housing for asymptomatic HIV-seropositive inmates, such a practice would require substantially increased resources to accommodate the large number of seropositive persons who would be identified under a mass testing program. The projections from this study indicate that separate housing for as many as 2,200 HIV-infected persons would need to be provided within the first year of mandatory testing. Consequently, it may be more difficult to provide separate but equal social, rehabilitational, and recreational facilities. The increased funding need may also decrease the quality of services and medical care provided to persons with AIDS because they would share facilities with a much larger group of seropositive persons.

If segregated seropositive prisoners are prevented from participating in work programs that lead to time off for good behavior, then increased costs for their medical care may accrue to the correctional medical system. Segregation can also result in a loss of confidentiality with labeling and stigmatizing that may inhibit rehabilitation. On release from prison, asymptomatic but publicly identified seropositive persons may suffer housing and employment discrimination. Segregating infected inmates may also provide a mixed message to inmates, their families, and the public at large once they are released into society and are no longer quarantined.

Even with mass screening and segregated housing, HIV transmission may still occur because some inmates tested soon after HIV infection will not test positive because of the lag between the time of infection and the time HIV antibody levels are detectable. This lag may be as long as six months and possibly longer.¹⁸ Thus, the presumed uninfected population would have to be repeatedly tested to assure complete "capture" of seropositive persons. Segregating identified HIV-Ab-positive inmates will not obviate the need for intensive AIDS education and risk-reduction measures in the general prison population.

The assessment by prison officials of the potential for HIV transmission within correctional facilities plays a key role in policy decisions regarding HIV testing and the housing of HIV-seropositive persons. While sexual activity and intravenous drug use are prohibited among inmates, these activities are well known to occur within prisons. Indeed, there have been documented outbreaks of sexually transmitted diseases and hepatitis B in prison populations, although the rate of transmission has been found to be on the order of 1%.^{19,20} Likewise, low but nonzero rates of HIV transmission have been documented in prison systems.^{5,12,21,22} Transmission seems to depend, however, on the prevalence of HIV and the behaviors known to transmit it, and these factors may vary widely in different regions. Follow-up studies of a cohort of entering and current inmates would provide the most definitive information regarding the transmission of HIV within correctional sys-

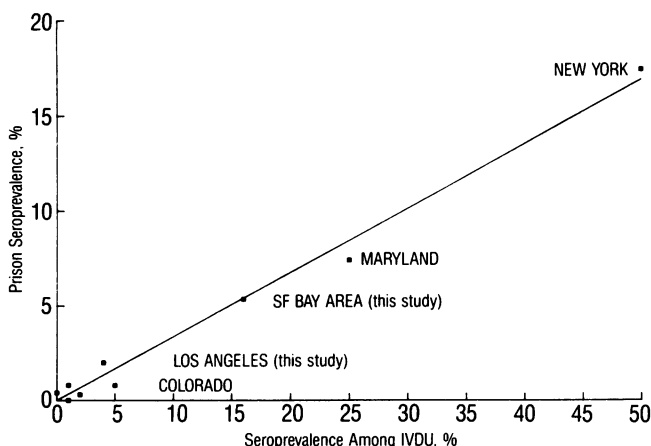


Figure 2.—The graph shows the seroprevalence of the human immunodeficiency virus antibody in prisoners in correctional systems compared with that of intravenous drug users (IDU) from the corresponding states. The figures for Missouri, New Mexico, Washington, and Wisconsin occur near the origin. The plotted regression line has an adjusted R^2 of .99. From Hammett,⁵ Greenspan,⁷ NY State Dept of Health,⁹ Wisconsin Division of Health,¹¹ and Centers for Disease Control.¹⁷

tems. The random assignment of some physically separate prison cohorts to have condoms and bleach made available to them might also provide valuable information on the prevention of HIV transmission in the correctional setting and should be considered. Studies providing reliable information in this regard would be useful in making policy decisions and in further targeting prevention efforts.

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